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H4P PEP PPEC

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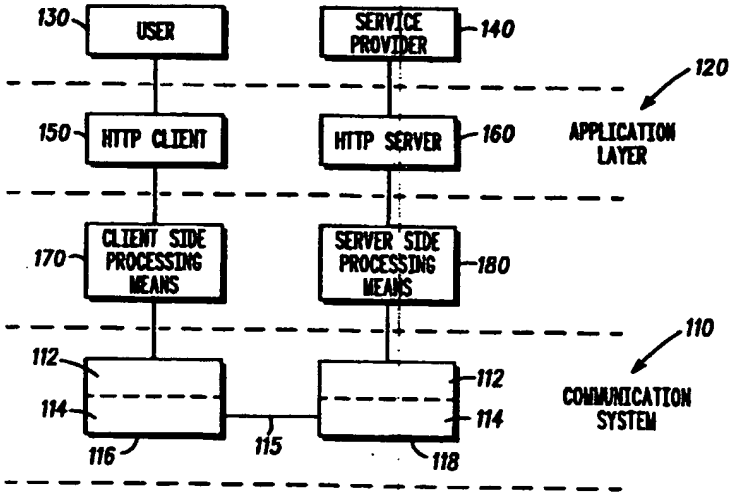
(54) Abstract Title
Error protection in a communications system

(57) A method of transmitting data in a communications system 110 with protocol layers comprising communications protocol layers 112, 114 and an application layer 120 corresponding to a data transfer protocol e.g. HTTP or WAP to which the data is subjected; the data being transmitted with a level of error protection that is varied as a function of the category of the data e.g. text, video, sound, according to a priority specification provided by a user 130. In one embodiment the data is transmitted between a client 150 and a server 160. The priority specification can be static, for example in the form of a configuration table, or can be varied dynamically. The level of error protection can be further varied dependent on the category of the data responsive to communication link (115) conditions of said communications system. Also described are an apparatus for transmitting data in a communications system; an apparatus for allocating a varying level of error protection to data to be transmitted in a communications system; and an apparatus for providing a priority specification for determining varying levels of error protection to be allocated to the transmission data in a communications system.



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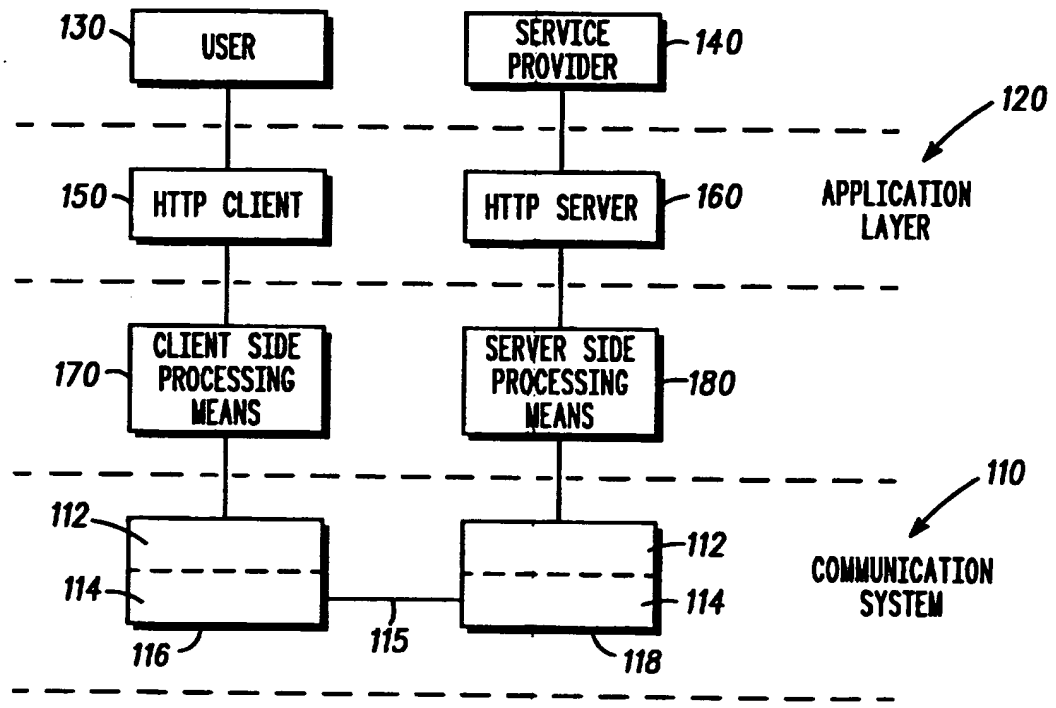
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.


130
USER
SERVICE PROVIDER
140
120
150
HTTP CLIENT
HTTP SERVER
160
APPLICATION LAYER
170
CLIENT SIDE PROCESSING MEANS
SERVER SIDE PROCESSING MEANS
180
110
112
114
116
115
112
114
118
COMMUNICATION SYSTEM

ERROR PROTECTION IN A COMMUNICATIONS SYSTEM

Field of the Invention

The present invention relates to transmitting data in a communications system with a plurality of protocol layers comprising one or more communications protocol layers and an application layer. The invention relates to aspects of transmitting such data with error protection. The present invention is applicable to, but not limited to, application level protocols such as the internet Hyper-Text Transfer Protocol (HTTP) and the Wireless Application Protocol (WAP). The present invention is applicable to, but not limited to, communications protocols in the form of radio protocols such as Terrestrial Trunked Radio Architecture (TETRA), and cellular radio protocols such as the Global System for Mobile communications (GSM) and the Universal Mobile Telecommunication System (UMTS) currently under standardisation.

Background of the Invention

Communications systems require internal structures, coding arrangements, formats of data packaging, multiplexing and so on in order to function. Such arrangements are often termed protocols. Such protocols are organised on a hierarchical basis, for example fundamental time division multiplexing or code division multiplexing details will form a low-level protocol, whereas logical channels imposed thereon can form a higher level protocol. As such protocol stacks are formed, and are well understood in the art. Such protocols are very clear cut in the case of communications systems operating to agreed harmonised standards, such as TETRA, GSM, and such as intended for UMTS.

More particularly, the above described protocol layers can be considered communications protocol layers, in that they will apply to arrangements used in the transfer of data from one entity to another within the communications system, irrespective of the information content within the traffic aspect of the data being communicated. However, the traffic data being communicated will often require to be subjected to its own protocol, namely a data transfer protocol, in order to be uniformly understood and processed at the different entities. Such a protocol level therefore gives rise to a further logical protocol layer, often termed the application layer. Well known and understood examples

of application layer protocols are the internet Hyper-Text Transfer Protocol (HTTP) and the Wireless Application Protocol (WAP).

Transmission of data through communications systems is prone to errors being introduced. Error correction techniques are known for alleviating such errors. One variety is forward error protection, in which redundancy is built in to messages such as to provide resilience to certain levels of error. Other possibilities include the use of cyclic codes, systematic codes, linear codes and so on.

It is a feature of advanced application layer protocols and current and impending communications protocols, that the underlying communications system is not aware of the content, or even the category of data being transmitted. For example, UMTS which is currently under standardisation is intended to provide a harmonised standard under which cellular radio communications systems will provide communications links suitable for transmitting a variety of data services, many of them involving multi-media data and high degrees of interaction, e.g. video, text, speech, other sound, facsimile, telemetry, and so on. When the communications protocols are based on packet switching, the communications system is even more unaware of the type of data being transmitted.

Generally speaking, the increasing sophistication of application layer protocols and the increasing flexibility with which different types of data are being transmitted creates a broad range of new engineering problems and challenges. Indeed, one of the challenges faced is to envisage what new opportunities arise to provide users with additional facilities in the light of such developments.

Summary of the Invention

According to one aspect of the present invention, there is provided a method of transmitting data in a communications system, as claimed in claim 1.

According to another aspect of the present invention, there is provided an apparatus for transmitting data in a communications system, as claimed in claim 10.

According to another aspect of the present invention, there is provided an apparatus for allocating a varying level of error protection to data to be transmitted in a communications system, as claimed in claim 25.

According to another aspect of the present invention, there is provided an apparatus for providing a priority specification for determining varying levels of error protection to be allocated to the transmission data in a communications system, as claimed in claim 31.

Further aspects of the invention are as claimed in the dependent claims.

The present invention advantageously provides an end user or a system related operator the flexibility and control to specify different levels of error protection according to whether the category of data is for example, text, video, sound, and so on. Thus, firstly inappropriate levels of error protection, be that insufficient or unnecessarily high, levels can be avoided in an absolute sense. Secondly, inappropriate levels can be avoided with respect to the individual needs of the user, rather than just on the basis of generalised standards imposed by some operator. Thus, different users with different levels of expectation can be accommodated, and/or a particular user can vary his relative requirements between say video and text, depending on the particular application he is using, and the purpose for which he is using it, for example distinguishing between leisure and professional usage. This is particularly useful in the case where the application level data is transmitted between a client of said application layer and a server of said application layer.

An advantage of certain further aspects of the invention is that a third party, such as an operator related to the communications system, can control the error protection given to responses received from the application layer server.

A preferred version of the present invention enables the level of error protection to be further varied depending on the condition of the communications system

links.

Additional specific advantages are apparent from the following description and figures.

Brief Description of the Drawings

FIG. 1 is a schematic illustration of aspects of an embodiment of the present invention.

Description of an Embodiment of the Invention

One particular embodiment of the invention is now described by way of example only. Fig. 1 shows, in the form of a schematic illustration, an arrangement including a communications system 110, comprising two levels of communications protocol 112 and 114. Further shown schematically are communications link 115, and two separate nodes 116 and 118 of the communications system 110. The nodes are any two locations, interfaces or the like at which two communicating parties respectively access the communications system. In the present embodiment, the two parties are a user and a service provider respectively, represented schematically in Fig. 1 by items 130 and 140 respectively. In the present embodiment the communications system is one supporting connections on the internet.

In the present embodiment the applicable data transfer protocol is HTTP, and the user employs an HTTP client 150 as his tool at the application layer level. It is to be appreciated that the present invention is also applicable to other data transfer protocols, including WAP. The application layer 120 is shown schematically in Fig. 1. The client in the present case is in the form of a world-wide web browser, in the form of software on a computer system used by the user. The client is requesting data from a HTTP server 160 at the application layer, which in the present case is in the form of a collection of information objects, in the sense of object-based structures whose accessible information content represents the data to be transmitted, and whose structures enable the

category of the information to be determined. The HTTP server 160 is under the control of service provider 140.

In the present embodiment the form of error correction available to be employed when the requested information is transmitted from the server 160 to the client 150 is forward error correction. It is to be appreciated however that other forms of error protection can be employed according to the present invention. More particularly, in the present embodiment the error protection consists of a technique which adds redundant coding information to the data to be transmitted. This redundant coding information determines the power to detect and correct transmission errors. Therefore redundancy is defined as the number of bits used over the minimum to encode a message unambiguously. Hence, the amount of redundancy included is varied so as to implement corresponding varied levels of error protection.

It can be seen that in the above error correction procedure, the level of error protection can be varied by changing the amount of redundant information used. By increasing the amount of redundant information, a higher level of error protection is provided, but with the trade-off of using more communications resource and also more processing power.

In the present embodiment the data requested by the user consists of some objects in the form of text and some objects in the form of video. Text represents one category of the data; video represents a different category of the data. The user in the present embodiment is primarily concerned that the content of the text be accurate, whereas he has only passing interest in the video. Thus, according to the present embodiment, he specifies with his request that a low level of error protection is required with the video object and a high level is required with the text object. In the present embodiment, only two such possible levels, i.e. high or low, are offered to the user, but in other embodiments a larger number of discrete levels can be available, or alternatively continuous or pseudo-continuous levels can be offered.

The processing means for providing the choices of error protection level are located, in terms of hierarchy, between the client and node 116 of the communications system, as represented by client-side processing means 170 in

Fig. 1. The levels can be presented to the user in any suitable terminology such that their significance is appreciated, e.g. terminology such as high/low, or numerically defined, e.g. an arbitrary quality rating.

In the present embodiment the user specifies the required levels of error protection as a function of the category of the data to the client-side processing means 170 by means of keyboard input in a way compatible with the browser interface and programme he is using. For example, one way the HTTP client 150 and the client-side processing means 170 can be implemented is in the form of two compatible programmes operating on the same computer system of the user. In this case, suitable prompts permanently added to the browser interface are presented to the user as a preferable input means for the user to specify the choices, but alternatively suitable prompts can be directly provided in initial interface transmissions from the server.

In the present embodiment the user thus provides a priority specification by inputting as part of his request the above described preferences for levels of error protection. The choice is then added to the transmitted request by client-side processing means 170. Instead of the data request plus error protection level priority specification being passed directly from node 118 to server 160, it is passed via server-side processing means 180 located on a hierarchical basis between node 118 and server 160 as shown in Fig. 1. The server-side processing means extracts the error protection level priority specification and passes on the request to the server 160 as per the normal HTTP protocol. The server 160 in response transmits the required data, consisting in the present case of a video object and a text object, to the server-side processing means 180 which based on the earlier extraction of the error protection level priority specification, determines the categories of data in the data received from the server, and adds the relevant error protection to the different objects of data according to their categories at the levels specified. It is noted however that in other embodiments the server-side processing means may merely inform the underlying communication system 110 of the level of protection needed when transmission of the message is made, and the communications system will then add the error protection at the specified levels. The data is then transmitted onwards to node 118 and then node 116 on to the client-side processing means 170 with the specified levels of error protection incorporated. Thereafter, any required

stripping out of error protection bits or post-transmittal error assessment is carried out in conventional fashion, at any appropriate stage in the communications process, although preferably at client-side processing means 170.

In the above embodiment, the user's category dependent error protection level priority specification was sent as part of his request for data, and thereafter the objects of data are simply sent in response from the server, with those error protection levels added by server-side processing means 180, without further feedback taking place. Thus the error protection level priority specification was, in effect, in the form of a static priority specification. Various forms of such static priority specification can be employed. One such possibility is to employ a configuration table. In the present case, even if the user did not know which categories of data were going to be present in the overall information he was requesting, he could anyway input choices to a presented configuration table which would include, say, the categories text, video, still photographs, line drawings, audio. The user would then allocate choices of required error protection level, in the present case high or low, to each such category, to thus form a configuration table, even though he did not know which of these categories was going to be present in the information he was requesting. This configuration table is arranged to be accessed as required by the client and/or the client-side processing means. One possibility is to store the configuration table for future reference, including if desired as a default setting for that user, for either all future requests to any server from that user, or alternatively for only future requests to that specific server from that user. Such configuration tables, can thereafter be stored at client-side processing means 170 or at server-side processing means 180.

Note that if client-side processing means170 is unable to determine the information content type being requested it can set up a temporary arrangement during which it initially transfers a configuration table as described above, but thereafter if any specified levels are altered by the user an updated message is sent to the server-side processing means 180. This represents one form of the user varying the error protection level priority specification dynamically. In other forms of dynamic variation, the user can continually update his choices, which is advantageous in that he can determine as he goes along whether a

currently supplied level of data integrity is meeting his needs. Also, such dynamic capability allows for changing user needs to be accommodated.

A further option is for the level of error protection to be further varied dependent on the category of the data responsive to communication link conditions of the communications system. Under this option, a condition of the communications link is monitored. For example, in the present embodiment, client-side processing means 170 carry out post-transmittal error assessment in conventional fashion as mentioned above and determine therefrom actual error rates that have been occurring. These are determined for each category of data, i.e. they are determined separately for the video data and the text data in the present case. Then, by means of pre-programmed algorithms, the numerical priority specification of the error protection levels applied are adjusted to provide a standard level of quality assigned to the priority specification level chosen by the user. Alternatively, such adjustment can be arranged such as it is only employed when certain threshold levels of determined error rate are broken. Instead of using post-transmission error assessment at client-side processing means 170, feedback from other one or more parts of communications system 110 can be used to provide information of the communication link conditions.

A further option is for the server-side processing means to process configuration data from a plurality of users and corresponding clients and client-side processing means. In this case the use of configuration tables is particularly advantageous, and the server-side processing means stores respective configuration tables for each user and then applies the appropriate respective configuration table to a request according to which user the request was received from. The server-side processing means are arranged to perform such processing in parallel for different requests according to routine processing algorithms.

Generally the server-side processing means can be implemented in the form of dedicated hardware, or software in a computer, or as a combination of software and hardware.

In an alternative embodiment, a priority specification of the type described above is specified by a third-party, such as an operator related to the communications system, i.e. a party other than the end-user or the service provider. In the case of the communications system described above, the third-party is a network operator of a network forming part of the communications system 110. In another example, where the communications system under consideration is a private mobile radio (PMR) system, say, and the communications protocol is WAP, say, then the third-party could be a dispatcher or other central controller of the communications system.

Although the above embodiments relate to either a single user, a plurality of users, or an operator inputting the priority specification or specifications, it is to be appreciated that the invention is not limited to such, and rather other sources or entities whose input would be advantageous are included instead or in addition. Furthermore, in other embodiments it is possible that a plurality of such inputs are combined and processed by the server-side processing means to arrive at overall functions of error level protection according to category of data. One possibility is for user priority specification to be the norm, but the server-side processing means are arranged to allow operator priority specification to over-ride the norm when required.

Claims

1. A method of transmitting data in a communications system, wherein said communications system comprises a plurality of protocol layers comprising one or more communications protocol layers and an application layer, said application layer corresponding to a data transfer protocol to which said data is subjected;
the method comprising the steps of:
providing a priority specification; and
transmitting said data with a level of error protection that is varied as a function of the category of the data according to said priority specification.

2. A method according to claim 1, wherein said priority specification is provided by a user.

3. A method according to claim 1, wherein said priority specification is provided by an operator related to said communications system.

4. A method according to claim 1, wherein said priority specification is provided by combining a priority specification input from a user and a priority specification input from an operator related to said communications system.

5. A method according to any preceding claim, wherein said data is transmitted between a client of said application layer and a server of said application layer.

6. A method according to any preceding claim, wherein said priority specification is in the form of a static priority specification.

7. A method according to claim 6, wherein said static priority specification is a configuration table.

8. A method according to any of claims 1-5, wherein said priority specification is varied dynamically.

9. A method according to any preceding claim, wherein said level of error protection is further varied dependent on the category of the data responsive to communication link conditions of said communications system.

10. An apparatus for transmitting data in a communications system, wherein said communications system comprises a plurality of protocol layers comprising one or more communications protocol layers and an application layer, said application layer corresponding to a data transfer protocol to which said data is subjected;
the apparatus comprising:
means for providing a priority specification; and
means for transmitting said data with a level of error protection that is varied as a function of the category of the data according to said priority specification.

11. An apparatus according to claim 10, wherein said priority specification is provided by a user.

12. An apparatus according to claim 10, wherein said priority specification is provided by an operator related to said communications system.

13. An apparatus according to claim 10, wherein said priority specification is provided by combining a priority specification input from a user and a priority specification input from an operator related to said communications system.

14. An apparatus according to any of claims 10-13, wherein said data is transmitted between a client of said application layer and a server of said application layer.

15. An apparatus according to any of claims 10-14, wherein said priority specification is in the form of a static priority specification.

16. An apparatus according to claim 15, wherein said static priority specification is a configuration table.

17. An apparatus according to any of claims 10-14, wherein said priority specification is varied dynamically.

18. An apparatus according to any of claims 10-17, wherein said level of error protection is further varied dependent on the category of the data responsive to communication link conditions of said communications system.

19. An apparatus according to any of claims 10-18, wherein said means for transmitting said data with a level of error protection that is varied as a function of the category of the data according to said priority specification comprises first processing means arranged between said application layer and said one or more communications protocol layers.

20. An apparatus according to any of claims 14-18, wherein said means for transmitting said data with a level of error protection that is varied as a function of the category of the data according to said priority specification comprises server-side processing means arranged between said server and said one or more communications protocol layers.

21. An apparatus according to any of claims 10-20, wherein said means for providing a priority specification comprises second processing means arranged between said application layer and said one or more communications protocol layers.

22. An apparatus according to any of claims 14-20, wherein said means for providing a priority specification comprises client-side processing means arranged between said client and said one or more communications protocol layers.

23. An apparatus according to claim 19, wherein said first processing means process priority specifications from a plurality of users.

24. An apparatus according to claim 20, wherein said server-side processing means process priority specifications from a plurality of users.

25. An apparatus for allocating a varying level of error protection to data to be transmitted in a communications system, where said varying level is a function of the category of the data according to a priority specification, and

where said communications system comprises a plurality of protocol layers comprising one or more communications protocol layers and an application layer, said application layer corresponding to a data transfer protocol to which said data is subjected;

said apparatus comprising:

means for receiving and storing said priority specification; and

means for allocating appropriate error protection levels according to category on the basis of said priority specification.

26. An apparatus according to claim 25, comprising processing means arranged between said application layer and said one or more communications protocol layers.

27. An apparatus according to claim 26, wherein said data is transmitted between a client of said application layer and a server of said application layer, and wherein said processing means comprises server-side processing means arranged between said server and said one or more communications protocol layers.

28. An apparatus according to any of claims 25-27, comprising means for processing priority specifications received from one or more users.

29. An apparatus according to any of claims 25-28, comprising means for processing a priority specification received from an operator related to said communications system.

30. An apparatus according to any of claims 25-29, wherein each said priority specification is in the form of a configuration table.

31. An apparatus for providing a priority specification for determining varying levels of error protection to be allocated to the transmission of data as a function of the category of the data in a communications system, where said communications system comprises a plurality of protocol layers comprising one or more communications protocol layers and an application layer, said application layer corresponding to a data transfer protocol to which said data is subjected;

said apparatus comprising:
means for receiving said priority specification; and
means for forwarding said priority specification.

32. An apparatus according to claim 31, comprising processing means arranged between said application layer and said one or more communications protocol layers.

33. An apparatus according to claim 32, wherein said data is transmitted between a client of said application layer and a server of said application layer, and wherein said processing means comprises client-side processing means arranged between said client and said one or more communications protocol layers.

34. An apparatus according to any of claims 31-33, wherein said priority specification is in the form of a configuration table.

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Application No:	GB 9901994.5	**Examiner:**	Keith Williams
Claims searched:	1-34	**Date of search:**	11 August 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H4P (PEP, PPEC)

Int Cl (Ed.6): H03M 13/00; H04L 1/00, 29/06, 29/08; H04Q 7/22

Other: Online EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A,E	GB 2331897 A	Motorola - see whole specification	1,10,25,31
A,E	GB 2331211 A	Nokia Mobile Phones - see whole specification	1,10,25,31
A	GB 2306278 A	NEC Copr. - see abstract	1,10,25,31
A	WO 98/36589 A1	Nokia Mobile Phones - see abstract	1,10,25,31
A	WO 96/02096 A1	Motorola Inc. - see abstract	1,10,25,31

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.